# PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

## PCT

### NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

| | |
|---|---|
| **Date of mailing** (day/month/year)<br>29 May 2000 (29.05.00) | |
| **International application No.**<br>PCT/GB99/03000 | **Applicant's or agent's file reference**<br>JL2252/P2860 |
| **International filing date** (day/month/year)<br>24 September 1999 (24.09.99) | **Priority date** (day/month/year)<br>24 September 1998 (24.09.98) |
| **Applicant**<br>LOWANS, Brian, Sinclair | |

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

18 April 2000 (18.04.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

| | |
|---|---|
| **The International Bureau of WIPO**<br>**34, chemin des Colombettes**<br>**1211 Geneva 20, Switzerland** | Authorized officer<br>Juan Cruz |
| Facsimile No.: (41-22) 740.14.35 | Telephone No.: (41-22) 338.83.38 |

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : G06K 9/74

A1

(11) International Publication Number: WO 00/17810

(43) International Publication Date: 30 March 2000 (30.03.00)

(21) International Application Number: PCT/GB99/03000

(22) International Filing Date: 24 September 1999 (24.09.99)

(30) Priority Data:
PCT/GB98/02876 24 September 1998 (24.09.98) GB

(71) Applicant *(for all designated States except US)*: THE SECRETARY OF STATE FOR DEFENCE [GB/GB]; Defence Evaluation and Research Agency, Farnborough, Hampshire GU14 0LX (GB).

(72) Inventor; and

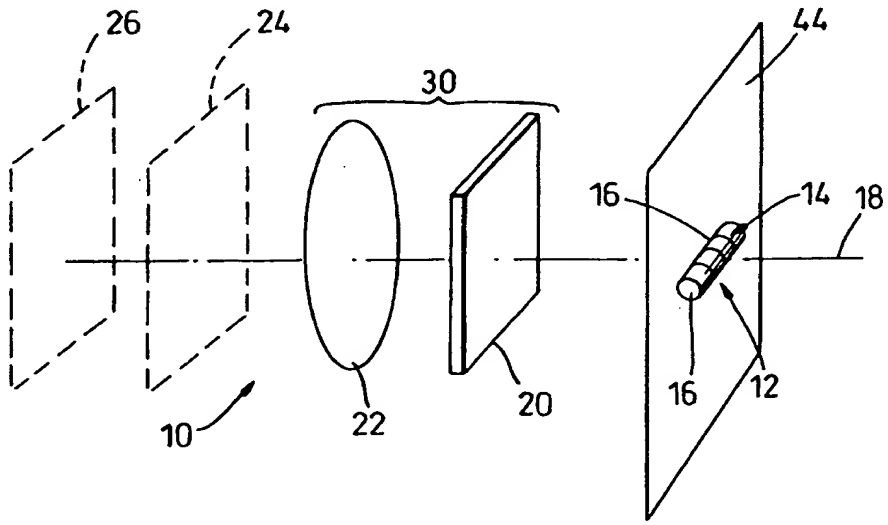
(75) Inventor/Applicant *(for US only)*: LOWANS, Brian, Sinclair [GB/GB]; Dera Malvern, St. Andrews Road, Malvern, Worcestershire WR14 3PS (GB).

(74) Agent: BARKER BRETTELL; 138 Hagley Road, Edgbaston, Birmingham B16 9PW (GB).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

**Published**
*With international search report.*

(54) Title: PROGRAMMABLE LENS ASSEMBLIES AND OPTICAL SYSTEMS INCORPORATING THEM




(57) Abstract

An imaging system (10) has a fixed lens combination (22), a spatial light modulator (SLM) (20) and a linear detector array (12). A scene image is scanned across a simple array (12) in a direction perpendicular to the array (12) by the SLM (20). This is achieved by displaying a diffraction pattern on the SLM that changes to achieve the scanning. The diffraction pattern displayed typically has a linear element (40) and a quadratic element (42). By having a programmably changed combined chirp pattern (36) displayed on the SLM, and by being able to change it thousands of times a second, an array with fast read out can take the place of a 2–D imaging array.

*FOR THE PURPOSES OF INFORMATION ONLY*

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| AL | Albania | ES | Spain | LS | Lesotho | SI | Slovenia |
| AM | Armenia | FI | Finland | LT | Lithuania | SK | Slovakia |
| AT | Austria | FR | France | LU | Luxembourg | SN | Senegal |
| AU | Australia | GA | Gabon | LV | Latvia | SZ | Swaziland |
| AZ | Azerbaijan | GB | United Kingdom | MC | Monaco | TD | Chad |
| BA | Bosnia and Herzegovina | GE | Georgia | MD | Republic of Moldova | TG | Togo |
| BB | Barbados | GH | Ghana | MG | Madagascar | TJ | Tajikistan |
| BE | Belgium | GN | Guinea | MK | The former Yugoslav Republic of Macedonia | TM | Turkmenistan |
| BF | Burkina Faso | GR | Greece | | | TR | Turkey |
| BG | Bulgaria | HU | Hungary | ML | Mali | TT | Trinidad and Tobago |
| BJ | Benin | IE | Ireland | MN | Mongolia | UA | Ukraine |
| BR | Brazil | IL | Israel | MR | Mauritania | UG | Uganda |
| BY | Belarus | IS | Iceland | MW | Malawi | US | United States of America |
| CA | Canada | IT | Italy | MX | Mexico | UZ | Uzbekistan |
| CF | Central African Republic | JP | Japan | NE | Niger | VN | Viet Nam |
| CG | Congo | KE | Kenya | NL | Netherlands | YU | Yugoslavia |
| CH | Switzerland | KG | Kyrgyzstan | NO | Norway | ZW | Zimbabwe |
| CI | Côte d'Ivoire | KP | Democratic People's Republic of Korea | NZ | New Zealand | | |
| CM | Cameroon | | | PL | Poland | | |
| CN | China | KR | Republic of Korea | PT | Portugal | | |
| CU | Cuba | KZ | Kazakstan | RO | Romania | | |
| CZ | Czech Republic | LC | Saint Lucia | RU | Russian Federation | | |
| DE | Germany | LI | Liechtenstein | SD | Sudan | | |
| DK | Denmark | LK | Sri Lanka | SE | Sweden | | |
| EE | Estonia | LR | Liberia | SG | Singapore | | |

# INTERNATIONAL SEARCH REPORT

[redacted] International Application No
PCT/GB 99/03000

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G06K9/74

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | DATABASE INSPEC 'Online! INSTITUTE OF ELECTRICAL ENGINEERS, STEVENAGE, GB LAMBERT A ET AL: "Optical image processing using liquid crystal displays" Database accession no. 5774678 XP002126433 abstract | 1-21 |
| X | & CONFERENCE PROCEEDINGS DICTA-95. DIGITAL IMAGE COMPUTING: TECHNIQUES AND APPLICATIONS, CONFERENCE PROCEEDINGS DICTA-95. DIGITAL IMAGE COMPUTING: TECHNIQUES AND APPLICATIONS, BRISBANE, QLD., AUSTRALIA, 6-8 DEC. 1995, pages 354-359, 1995, Brisbane, Qld., Australia, Australian Pattern Recgnition Soc, Australia abstract | 1-21 |

-/—

[X] Further documents are listed in the continuation of box C.

[ ] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 21 December 1999 | 11/01/2000 |

| Name and mailing address of the ISA | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016 | Granger, B |

Form PCT/ISA/210 (second sheet) (July 1992)

# INTERNATIONAL SEARCH REPORT

[redacted] International Application No
PCT/GB 99/03000

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | QING TANG ET AL: "MULTIPLE-OBJECT DETECTION WITH A CHIRP-ENCODED JOINT TRANSFORM CORRELATOR" APPLIED OPTICS,US,OPTICAL SOCIETY OF AMERICA,WASHINGTON, vol. 32, no. 26, page 5079-5088 XP000393407 ISSN: 0003-6935 the whole document | 1-21 |
| A | MANASSON V A ET AL: "OPTICALLY CONTROLLED SCANNING ANTENAS COMPRISING A PLASMA GRATING" IEEE ANTENNAS AND PROPAGATION SOCIETY INTERNATIONAL SYMPOSIUM,US,NEW YORK, NY: IEEE, page 1228-1231 XP000784678 ISBN: 0-7803-4179-1 the whole document | 1-21 |

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

15

# PATENT COOPERATION TREATY

# PCT



## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

| Applicant's or agent's file reference | FOR FURTHER ACTION | See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416) |
|---|---|---|
| JL2252/P2860 | | |
| International application No. | International filing date *(day/month/year)* | Priority date *(day/month/year)* |
| PCT/GB99/03000 | 24/09/1999 | 24/09/1998 |
| International Patent Classification (IPC) or national classification and IPC<br>G06K9/74 | | |
| Applicant<br>THE SECRETARY OF STATE FOR DEFENCE et al. | | |

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

| Date of submission of the demand | Date of completion of this report |
|---|---|
| 18/04/2000 | 22.12.2000 |
| Name and mailing address of the international preliminary examining authority:<br>European Patent Office<br>D-80298 Munich<br>Tel. +49 89 2399 - 0 Tx: 523656 epmu d<br>Fax: +49 89 2399 - 4465 | Authorized officer<br>Casteller, M<br>Telephone No. +49 89 2399 2666 |

Form PCT/IPEA/409 (cover sheet) (January 1994)

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB99/03000

## I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*:
**Description, pages:**

| | | | | | |
|---|---|---|---|---|---|
| 1-27 | as originally filed | | | | |

**Claims, No.:**

| | | | | |
|---|---|---|---|---|
| 1-17 | as received on | 16/10/2000 | with letter of | 16/10/2000 |

**Drawings, sheets:**

| | |
|---|---|
| 1/7-7/7 | as originally filed |

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   - ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
   - ☐ the language of publication of the international application (under Rule 48.3(b)).
   - ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   - ☐ contained in the international application in written form.
   - ☐ filed together with the international application in computer readable form.
   - ☐ furnished subsequently to this Authority in written form.
   - ☐ furnished subsequently to this Authority in computer readable form.
   - ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   - ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   - ☐ the description, pages:
   - ☒ the claims, Nos.: 18-21

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

   *(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

## V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | | |
|---|---|---|---|
| Novelty (N) | Yes: | Claims | 1-17 |
| | No: | Claims | |
| Inventive step (IS) | Yes: | Claims | 4-7, 13-16 |
| | No: | Claims | 1-3, 8-12, 17 |
| Industrial applicability (IA) | Yes: | Claims | 1-17 |
| | No: | Claims | |

2. Citations and explanations
   **see separate sheet**

## VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
**see separate sheet**

**Re Item V**

**Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Reference is made to the following documents:

   D1: A. LAMBERT et al.: "Optical image processing using liquid crystal displays", DATABASE INSPEC [Online] INSTITUTE OF ELECTRICAL ENGINEERS, STEVENAGE, GB, Database accession no. 5774678, XP002126433

   D2: A. LAMBERT et al.: "Optical image processing using liquid crystal displays", CONFERENCE PROCEEDINGS OF DICTA-95 - DIGITAL IMAGE COMPUTING: TECHNIQUES AND APPLICATIONS, Brisbane, Qld., Australia, 6-8 DEC. 1995, pages 354-359, 1995, Australian Pattern Recognition Society, Australia; XP0008655743

   D3: EP-A-0 547 599 (TEXAS INSTRUMENTS INC.)

   D4: US-A-5 448 395 (M.A. LOPEZ et al.)

   D2 is the full-text version of the article summarized in D1. D3 and D4 have been cited by the applicant.

2. The subject-matter of claims 1 and 12 does not involve an inventive step as defined in Article 33(3) PCT and, consequently, the inventive step question set forth in Article 33(1) PCT must be answered negatively.

3. The problem considered in D3 and D4 is that of controllably directing selected portions (e.g. pixels) of an image onto a small-size light detector.
   In D3, each pixel of each frame of a video sequence is directed onto a single-cell sensor 15 by means of a movable pixel element 41 and a lens 14 (D3, column 3, lines 5-9, column 4, lines 12-19). By controlling said movable pixel element 14, which is part of a spatial light modulator (heretofore SLM) 11 implemented by a deformable mirror device, each pixel of an image frame can be directed onto the sensor, one pixel at a time during a so-called pixel-time (D3, column 4, lines 51-55).
   One or more movable pixel elements can be switched (possibly with different tilt positions) so as to implement a pattern on the SLM that directs the desired portions of the input image onto the one (or more) sensors (D3, from line 51 of column 6 to

line 13 of column 7).
In D4, a wide field of view can be focused on a small-size electro-optical sensor, e.g. 128x1 or 128x128 (D4, column 1, lines 13-17 and 19-22) without any mechanical moving parts by means of an optical system including an SLM 28 having plural shutters 30 (see fig. 2) implemented by either liquid crystals or silicon-micro-mirrors (D4, from line 61 of column 1 to line 2 of column 2; see also column 2, lines 52-54). The wide field of view image is divided into a plurality of contiguous sub-images, each sub-image being sequentially focused onto the sensor one-at-a-time (D4, column 2, lines 4-21). The shutters of said SLM can be controllably opened so that various "patterns" are created thereon, e.g. they can be opened sequentially one-at-a-time (D4, column 4, lines 18-22) or they can be all opened (D4, column 4, lines 31-36) and/or closed either singularly or in groups (D4, column 4, lines 36-40).

4. The subject-matter of present independent claims 1 and 12 lacks an inventive step when compared with the disclosures of either D3 or D4 because both prior art arrangements include an SLM on which, as recited in claims 1 and 12, "a pattern" (claim 1, line 4) is displayed and modified so as to "scan the scene image over the detector over time" (claim 12, line 6).
Neither the claimed pattern, nor the claimed SLM are further characterized in the independent claims, they are only mentioned therein.
Therefore, the fact that the pattern an the SLM of the present application might differ from those of either D3 or D4 needs not to be considered for assessing the inventive merit of the claimed subject-matter.
The subject-matter of **claims 1 and 12** does not therefore involve an inventive step (Article 33(3) PCT).
Dependent claims 2, 3, 8-11 and 17 apparently refer to implementation details and additional features of the invention which add nothing inventive to the subject-matter of the claims from which they depend. As the parent independent claims do not meet the inventive step requirements of Article 33(3) PCT, these requirements would also not be met by an independent claim amended so as to include the subject-matter of said dependent claims.

5. The present international application, considered as a whole, differs from the prior art arrangements of e.g. D3 and D4 by the particular types of displayed pattern.
The application describes (cf. e.g. page 12) and claims, cf. e.g. **claims 4-7 and 13-**

**16**, that said displayed pattern is the binarized pixel representation of the linear combination of a quadratic chirp function 42a and of a diffraction grating 40.

6. Although neither D3 nor D4 discloses or even only suggests generating chirp function and diffraction grating patterns on the SLM, it is generally known in the art e.g. from D1/D2 that patterns can be controllably generated on a SLM, notably including linear diffraction gratings and chirp functions, either alone or in combination.
D2 describes generating on said SLM a chirp exponential function (cf. paragraph "3." bridging pages 356 and 357) and a modified chirp function obtained by multiplying a centred chirp function by a complex valued constant, which has the effect of producing an off-centre chirp (cf. page 358, paragraph "4."). It is self evident that the modified chirp function of D2 is thus equivalent to the combination of a linear diffraction grating with a chirp function (cf. e.g. figures 12A, 12B and 12D of the present application).
The problem considered in D1/D2 is that of performing defined small shifts of the image, that is, image shifts being a fraction of the detector pixel size. It is in fact desired to extract sub-pixel information from the image e.g. by correlation. This problem is solved by using the SLM with a chirp function shifted slightly off-centre so that it will optically behave like a misaligned lens (cf. D2, page 359, last paragraph "6.").
D2 compares the range of image shifts obtainable by using a chirp function as opposed to those possible by using a traditional phase ramp in the Fourier transform plane (cf. paragraph "5." on pages 358 and 359), and sets out that a larger range of shifts are possible by using the chirp function. However, it appears that instead of using said larger range of shifts for performing larger macroscopic image shifts, as done in the present application, D2 limits itself to small but accurate sub-pixel image shifts, and that therefore D2 teaches away from the invention.

7. In conclusion, the problem solved by the invention and by the arrangements of D3 and D4 is the same, namely scanning an image scene across a detector over time by means of an SLM.
The invention solves this problem by using an SLM adapted to display and modify a pattern, said pattern being composed of a linear diffraction grating and of a chirp function, so as to cause the SLM, in use, to sequentially direct onto the detector light from a plurality of different angular or depth regions of the observed image scene.

Although it is generally known e.g. from D1/D2 that chirp functions on an SLM have the capability of shifting an image transmitted through the SLM either laterally or in the depth direction, this capability is exploited in D1/D2 only to perform accurate sub-pixel shifts so that e.g. correlation can be calculated with increased precision.
There is no explicit indication in D1/D2 that said shifting capability could be also used to perform large image shifts and thus solve the problem considered and solved with other means (i.e. without the invention patterns being created on their SLM's) in D3 and D4, as these documents neither disclose nor even only suggest generating chirp function and diffraction grating patterns.
Therefore, the subject-matter of dependent claims 4-7 and 13-16, in combination with the subject-matter of the claims from which they depend, appears to be novel and non-obvious with respect to the disclosures of the available prior art. It is also evident that the invention is industrially applicable.
The requirements of paragraphs (1) to (4) of Article 33 PCT are thus not met by the subject-matter of independent claims 1 and 12, and their dependent claims 2, 3, 8-11 and 17, but would have been met by the subject-matter obtained by combining claims 1 and 12 with their dependent claims 4-7 and 13-16.

## Re Item VII
## Certain defects in the international application

8. The following defects have been noted in the present international application.
At page 19, line 11, "have" should probably read "how".
In figure 9, "parrallel" is obviously misspelled.
In dependent claim 4, the term "substantially" is used twice but is considered to be vague, unclear and undefined: its use should have been avoided.
In independent claim 12, there is no antecedent for "the controller" feature mentioned at line 6 thereof.
Dependent claim 16 is defined as being possibly dependent from itself.

## CLAIMS

1. An optical assembly having an optical input, a spatial light modulator (SLM), a controller controlling the display of the SLM, and a detector; the controller being adapted to modify a pattern displayed on the SLM so as to cause the SLM, in use, to control the radiation incident upon the SLM from the optical input so as to direct onto the detector radiation from a selected surface or region in 3-D space in the scene that the optical assembly is observing.

2. An assembly according to claim 1 in which the controller is capable of controlling the SLM to direct onto the detector radiation from any notional surface or region in 3-D space in the scene that the optical assembly is observing.

3. An assembly according to claim 1 or claim 2 in which the radiation from the selected surface or region in 3-D space in the scene is focused onto the detector.

4. An assembly according to any preceding claim in which the pattern exhibited by the SLM is programmed by a computer/controller and is capable of being changed rapidly.

5. An assembly according to any preceding claim in which the SLM has a rate at which its display can be changed and the controller is capable of programming the pattern to change at substantially as fast a rate as that at which the display of the SLM is capable of being changed.

6. An assembly according to any preceding claim in which the pattern on the SLM is capable of being changed at least a thousand times a second.

7. An assembly according to any preceding claim in which the pattern has a component composed of a substantially linear diffraction grating pattern and a component comprised of a substantially a chirp function.

8. An assembly according to any preceding claim in which the controller has a library of possible linear and/or quadratic or higher order functions and a selected combination of linear and quadratic or higher order functions from the library are, in use, applied to the SLM.

9. An assembly according to any preceding claim in which the detector comprises a line array of detector elements or a simple array of detector elements having an elongate length and the controller is adapted to control the display on the SLM to scan the scene image over the detector array in a direction generally transverse to the direction of the line array, or transverse to the elongate direction.

10. An assembly according to any preceding claim in which the controller is adapted to scan different angular portions of the scene (angularly disposed in azimuth and/or ascension relative to the optical axis of the assembly) by modifying the linear component of a combined linear function and chirp function.

11. An assembly according to any preceding claim in which the controller is adapted to focus different depth regions of 3-D scene space over the detector by controlling the SLM to display patterns with different combined chirp functions.

12. A programmable focus element assembly which includes a programmable SLM capable of displaying light-modulating patterns which in use control the depth focus and direction from which light is focused by the lens assembly.

13. The use of a linear grating and/or a chirp grating exhibited on a programmable SLM to control the part of a scene that is directed onto a detector.

14. The use of claim 13 in which points in 3-D space are sequentially in time directed, or focused, onto a detector, the SLM being programmed by the controller to direct, or focus, different points in space onto the detector at different times.

15. A method of directing a scene image onto a detector comprising using a programmed SLM to control the x-y part of the scene image that is directed onto the detector and/or the imaged plane of the scene in the z direction that is in focus, the scene-detector direction being in the z direction.

16. A method according to claim 15 in which a chirp is applied to the SLM.

17. A method according to claim 15 or claim 16 in which a linear grating is applied to the SLM.

18. A method according to claim 15 or claim 16 in which the orientation of the linear grating and/or the spacing of the lines of the

grating are controlled so as to control the location of the region of the scene that is directed onto the detector.

19. A method according to claim 16 or any claim dependent directly or indirectly on claim 16 in which the chirp is used to determine the distance from the detector of the plane in 3-D space in the scene that is focused to the detector.

20. A method according to any one of claims 15 to 19 in which the display on the SLM is programmably controlled so as to scan the scene image over the detector over time, with the controller taking time-spaced records of what the detector detects.

21. A method according to any one of claims 15 to 20 in which the programmed SLM compensates for aberration in an optical system.